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Bangkok, 20-28 February 1991
Item 4 of the provisional agenda*

COUNTRY REPORTS ON THE PROGRESS MADE SINCE THE ELEVENTH CONFERENCE

Cartographic activity in the USSR

Paper submitted by the USSR**

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* E/CONF.83/1.

** Prepared by Dr. V. R. Jashenko, President, Main Administration of Geodesy and Cartography, Moscow.

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National mapping of the Soviet Union is entrusted to the National geodetic service known as the Main administration of geodesy and cartography under the Council of Ministers of the USSR (GUGK USSR) that carries out fundamental and applied geodetic, gravimetric, and cartographic operations including compilation and up-dating of topographic, thematical and shelf bottom maps, as well as aerial and space surveys, special engineering and mining geodetic operations.

The Service embraces several research institutes and specialized instrument-building factories, over 30 regional agencies engaged in geodetic and cartographic operations and mapediting as well as a number of technical secondary schools responsible for training the specialists on secondary level.

The highest-level specialists are trained in two specialized and about 30 politechnical high schools of the USSR.

Geodetic and cartographic productional agencies generally use domestic technologies, instruments, and equipments.

Horizontal and vertical datums

The territory of the USSR is provided with sufficiently dense horizontal and vertical geodetic networks. The National horizontal datum consists of about 600,000 stations of the 1st-, 2nd-, 3rd- and 4th-order-triangulation; the National vertical datum comprises over 800,000 benchmarks of the 1st-, 2nd-, 3rd- and 4th-order levelling; and the Fundamental first-order gravity network consists of about 240 stations.

The astrogeodetic network of the USSR formed by the 1st- and 2nd-order networks has the accuracy of 1 to 370,000 for the baselines, 1,2" for Laplace azimuths, and 3-4 m for coordinates over the distance of several thousands km.

The general adjustment of the astrogeodetic network of the USSR and computer-based compilation of coordinate catalogues are now being completed. The total number of normal equations to be solved is about 350,000.

The levelling network of the USSR, as to its homogenity and the rigour of treatment, is a unique geodetic construction satisfying all the requirements and recommendations of the International Association of Geodesy. The Geodetic service carries out systematical up-dating and densification of the network because of the inevitable loss of a certain part of benchmarks and the vertical crustal movements. All 1st-order lines and

some 2nd-order lines are relevelled at least once in 25 years and in seismically active areas once in 15 years. From these relevelling data the map of recent vertical crustal movements for all the territory of the USSR has been compiled.

A new adjustment of the levelling network of the 1st and 2nd order should have been completed by 1995 and the National levelling data base created.

The Geodetic service of the USSR carries on a complex of research and productional operations for studies of geodynamic processes in geodynamic and technogenetic test areas established in seismically active regions and in areas of mineral extraction and hydroelectric power stations. In the latter case the effect of human activity on behavior of earth crust is investigated. Crustal deformation monitoring data is used for reliable forerunners studies and temporal and spatial earthquake prediction.

The National gravity net of the USSR is used for precise determination of the parameters of the Earth gravitational field from terrestrial and satellite data as well as for metrological standardization of gravity surveys of different accuracy and application. It is also used with horizontal and vertical nets for determination of the figure and the size of the Earth.

The National horizontal and vertical geodetic datums as well as the National gravity network provide hence not only horizontal and vertical control for mapping at every scale but also data for resolving of a number of scientific problems.

Aerospace surveys

Aerial survey in the USSR for solution of economic problems is carried out both from special airsurvey aircrafts and from specially equipped aircrafts, helicopters, and microlight carriers. Special aircrafts TU-134 CX and An-30 are used for aerial surveys at small and middle scales, and specially equipped aircraft An-2, helicopters Mi-8, Ka-26, and microlight carriers are used for large-scale surveys.

Depending on the problems to be solved, airsurvey carriers are provided with cameras of focal length from 50 to 500 mm, gyrostabilization and precision-navigation systems.

For further improvement of information contents the aerial survey equipment is constantly improved in the USSR through modification of geometric and energetic parameters of lenses, forward motion compensation etc. as well as the problem of high-precision autonomous determination of external orientation parameters is now resolved. The improvement of airsurvey techniques and instrumentation is carried on both in GUGK and other departments of the USSR.

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Remote sensing of the Earth from space that is now widely used for topographic and thematic mapping is accomplished from permanent manned orbital stations "Saljut", in the latest years from the station "Mir" and automated space apparatus "Resource-F1" and "Resource-F2". Space survey data is distributed to more than 900 agencies of various ministries and departments. Some survey data is sold abroad according to contracts and individual requests.

The automatic space stations "Resource-F1" are equipped with photographic twin camera KFA-1000 with lens focal length of 1000 mm, size of images of 30x30 cm, longitudinal overlap of 60%, lateral overlap of 20%, relative lens opening of 1:10, width of coverage strip (2 apparatus fan-like) of 180 km, film supply for one apparatus of 1,700 exposures, forward motion compensation.

Space apparatus "Resource-F2" are equipped with 4-channel multispectral camera MK-4. The camera is provided with special high-precision lens securing resolution of 150 L/mm as to absolute contrast target. The focal length is 300 mm and the size of the window is 180x180 mm. The compensation of image motion due to angular satellite movement is achieved by linear displacements of the flattening table. The ground resolution of the image is from 5 to 8 m depending of the flying height and the spectral range of the survey.

The main application sphere of the remote sensing from space is compilation and up-dating of topographic and thematic maps.

Topographic and shelf surveys

The territory of the USSR despite its rather hard geographical and climatic conditions is now completely covered with topographic maps at the scales of 1 to 1,000,000; 1 to 100,000; 1 to 100,000; and 1 to 25,000. The cities and towns of the country are mapped at the scales of 1 to 2,000 and 1 to 5,000. Considering the tremendous area mapped, it is an impressive achievement of the Soviet cartography.

Topographic map-making in the USSR is carried out mainly by the photogrammetric technique but the surveys at larger scales (1 to 1,000 and 1 to 500) are performed by terrestrial methods, such as tachometer (studia surveying).

Digital methods with development of digital terrain models and cartographic data banks having influence upon all technological phases, from map compilation through updating to map delivery to the users are systematically introduced but the progress is relatively slow.

Topographic surveys of sea and ocean shelf areas as well as of bottoms of internal reservoirs connected with increased economic activities in aquatorial areas, such as prospecting and extraction of minerals, construction of special engineering structures, environmental studies, are actively pursued. The scale of the surveys varies from 1 to 2,000 to 1 to 50,000 but in some distant shelf areas is 1 to 100,000. Productional agencies of GUGK USSR carrying out these surveys use thereby modern technology such as small-sized echolots, sonars for measurements of sound propagation velocity in water, side-looking and topographic hydrolocators. Horizontal positioning of survey carriers is performed by radiogeodetic and satellite navigation systems.

Small-scale and thematic mapping

GUGK USSR systematically produces maps for different branches of the economy, education, science, tourism as well as for individual needs. The number of different maps and atlases is about 800 per year.

There are two principal groups of these maps: general geographical maps showing geographical physical characteristics of the earht and its regions; and thematical maps showing natural components and complexes as well as territorial and branch structure of the economy.

General geographic (folded) maps for territories of the USSR, Union republics, autonomous republics, krai and oblast (smaller administrative units) at various scales as well as a series of atlases and maps of practically all states and territories of the world are produced in a great number of copies and are very much in demand.

Thematic mapping of individual regions of the country is often carried out by GUGK USSR and other interested departments in the frame of special joint study projects with wide utilization of remote sensing data. Thematic maps produced as a result of these projects are badly needed for detailed study of variations of the environment (relief, vegetation, landscape, hudrography etc.), resolving of ecological problems and, therefore, for the optimal land management.

Complex studies revealed, e.g., a great supply of fresh water suitable for pasture watering in the semi-desert area of Aral-lake which was later confirmed by boring data, a number of mineral deposit indications in other regions of the Middle Asia, and also enabled a more precise estimation of mountain snow and ice cover, water and hudroelectric resources as well.

Thematic mapping dedicated to studies of other planets, in particular, Moon and Venus is actively pursued in the Soviet Union. Space survey data enabled mapping of the reverse side of the Moon, detailed representation of the relief of Mars and Mercury, photointerpretation of surface structures of Venus, Jupiter and Saturn. Of special interest is the space survey of Moon's surface. Soviet automatic stations "Zond-6", "Zond-7" and "Zond-8" have been successfully used for this purpose. Optico-mechanical scanning of images from automatic interplanetary stations "Luna-3", "Luna-12", "Mars-3", "Mars-4", and "Mars-5" is applied for map compilation. In the report period the atlas "Surface of Venus" (1989) and 27 sheets of the photomap of Venus at the scale of 1 to 5,000,000 (1987-88) have been published.

Great attention in the USSR is paid to school and educational cartography. There are about different maps and atlases for courses in geography, astronomy, history, and natural science that are supplemented by such cartographic products as "Educational World Atlas", "Geographical World Atlas" (for teachers) and a number of atlases of smaller administrative units of the USSR. The atlas "World and Man" for children of pre-school age and low-grade schoolchildren has acquired a special popularity among them. Unique new thematical map series for higher schools meant as help in training and research in geography, geology, soil study,economics and other spheres are produced by GUGK USSR. Annual production of educational works amounts to 80 millions copies.

The cartography for tourism is actively developing in recent years. The maps containing touristic itineraries of all kinds and based on large- and middle-scale topographic maps are of great informative value and may be used by hikers, hunters, and anglers as well.

Many maps, atlases and city plans are edited both in Russian and in foreign languages.

Nowdays, the global problem of vivid interest for humanity is the state of environment, and it is the task of the world cartographic community to create a world wide system for studies and cartographic representation of the environment from terrestrial and remote sensing data. Geodetic service of USSR would gladly take part in corresponding international projects and share its rich experience in this field.

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CARTOGRAPHIC DATA ACQUISITION AND SUPPORTING ACTIVITIES: HYDROGRAPHIC SURVEYING AND NAUTICAL CHARTING

Integrated topographic survey of shelf areas

Paper submitted by the USSR**

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* E/CONF.83/1.

** Prepared by Dr. E. V. Gromov, Director, Moscow Airgeodetic Enterprise.

The problems connected with study and exploration of sea bottom are gaining more and more attention in present specifically the problems connected with small depth shelf areas.

An intensive growth of shelf studies requires a perfomance of topographic survey of sea bottom.

A level of work accuracy depends on its destination. As the result of the shelf survey topographic maps which will be a continuation of land maps, can be produced. Such topographic maps will show batimetric data, bottom vegetation, sea fauna, soils. Also salinity and water temperature are measured during the works. These toographic maps are used for generation of navegational maps, study of specific water areas, geologic survey and design works, fishery, building of various engineering structures etc.

So the results of the on-shelf works can be used by:

- geodests,
- geologists for prospecting mineral resources,
- navegators,
- designers of various hydrotechnical facilities,
- mineral exploration companies,
- fishing company and under-water cultivating companies.

The execution of sea geodetic works consists of the following:

- correct on-sea positioning of points and sections, previously marked in the projects (geological and geophisical observations, designed positioning of the vessel);
- acquisition of navegational and geodetic data required for management of technological processes;
- vessels and ships navegation upon the preset programme;
- calculation of vessels coordenates during sea works perfomance;
- batimetric measurements (points and profiles).

The following is required for topographic survey of shelf:

1) equipment carrier - a vessel;
2) measuring equipment - echo sounder, water sound speed meter, thermometers,
3) navegational equipment - systems of near and far range action;
4) qualified staff.

A technology of the works consists in regular coverage of the explored water area by sounding tacks. The distance between tacks depends on the scale of survey and distance between the contour lines can be of 50 to 1500 metres.

The requirements of different branches of national economy to topographic maps are very wide. In order to meet these requirements within the minimum period and with minimum espenses there must be reliable approach to composition and mergering diversified types of survey works. The cost of the equipment carrying vessels is a major kind of expense for shelf mapping.

Main Adminiatration for geodesy and cartography of the USSR has carried out multiple experimental and industrial projects on shelf survey , which allow to make conclusion on techniques of integration of that survey.

The following issues are common for shelf mapping:

- development of coast and sea altimetric and planimetric networks;
- determination of planimetric position of the points, depth sounding and obtaining of specific information for thematic maps;
- level measurements.

The specific information for thematic maps include the following types of surveys: gravimetric,magnetic, hydrometric, soils specificationing; bentos survey, diver hydrobiological survey, ecological investigations etc.

An important stage of the shelf topographic survey is a survey by topographic scanning sonar, which gives a possibility of survey of inter-tacks intervals in laboratories located near to the worksite areas and avoids extra tacks. Such survey can add geomorphological data to topographic map.

The soil survey includes mapping of bottom sediments, batimetric and hydrosonning survey. The detailed geomorphological survey of the sea bottom is carried out.

However the experience proves that for intergrated mapping it is feasible to carry out echo sounding together with sonar survey. Also an analyses of sonar data, soils survey, photo and TV survey must be done simultaneously with biological survey. That process of survey integration must include bentos survey which is goaled on sea bottom fauna classification. The cartographic interpretation of bentos survey unites the bentos data collected from observation points and than the specialist will draw a countour line closing specific fauna societies living over the bottom ground or inside it. Mapping of bottom life on the topographic map has the same sense as a presentation of vegetation on land topographic maps. That is the points which unite the content of the above mentioned maps and there is its main difference from navegational maps.

Thus the mentioned types of surveys effected on common topographic base give practically complete

image of the surveyed area being inventory information, despite this type of the cadastre allows for its thematic mapping.

As to mapping of geophysical fields - gravitational, geomagnetic - such kinds of surveys allow to perform together with toographic survey and solution of the above mentioned main geodetic assingment an important economic task which is a location of mineral deposists, first of all of oil and gas, by field anomalies, can be also solved.

Moscow Geodetic enterprise (USSR) has carried out the similar works East-Siberian, Okhotsky, Caspian and other sea shelf survey with very encouraging results. In this respect recently a remarcable progress has been done in preparation and organization of works, reliable analysis of performed surveys etc. Now the USSR is covered completely by precised gravimetric survey. The combined models prepared in the USSR are, dur to International gravimetric survey, correct and reliable.

As the result of the performed works the following should be mentioned:

- the USSR has National basic gravimetric network (NBGN), which determines gravimetric system of the USSR indepently of foreign systems and is reliably connected with International gravimetric system. The USSR gravimetric system determines level, scale and metrological base for all types of of gravimetrical works carried out in the USSR for economic(deposits prospection) and scientific (geodynamics studies and modifications of gravimetric field of the Earth) purposes;
- gravimetrical national network of 1 order was created in the USSR - this unic geodetic formation has no analogues in the world compared in measurements accuracy, surface coverage and sinalization of the points. The network of the first order allows for a development of total gravimetrical survey of the country;
- gravimetrical survey of Far East seas and separate water areas of Pacific Ocean was carried out, also gravimetric survey of Artics from ice. This allowed to calculate accurately the altitudes of geoid, plumb deviation on vast territory of the USSR and in intermediate coast - sea and ocean bottom area.

An important stage of gravimetric survey in Arctics is the integration of gravimetric and magnetic surveys carried out by Moscow Airgeodetic Enterprise on Novosibirsky islands. That survey allowed to get the data necessary for independent aircraft navegation and indicated on the correlation of anomalies of gravimetric and geomagnetic fields. High quality of gravimetric and magnetic surveys on Novosibirsky islands by the judgement of experts from Ministry of Geology of the USSR gives all arguments for beginning of prospection works and determines

a necessity of continuation of these kinds of surveys on the islands.

The prospects of development of gravimetric works for exact calculation of Earth gravimetric field and precalculation of satellites tracks are connected with the solution of a number of geodetic assignments such as:

- reduction of angle changes of astronomic and geodetic network of the USSR (for example, similar works abroad were done only in the USA), preparation of gravimetric maps which jointly with topographic maps allowed for calculation of FAI anomalies (sheets 5x7,5) and deviation of plumb (0,5" - I,0" for plane areas and 2" for mountains).
- calculation of the altitudes of quasi geoid by astronomic and gravimetric levelling for the whole USSR territory and determination of elements of orientation of Krassovsky ellipsoide relatively to general Earth ellipsoide.

Data from different kinds of gravimetrical survey are used for geological investigations. Small-scale surveys detect the areas for detailed studies. The results of detailed surveys by the maps of 0.05 - 0,5 mGal distance can be used for study of oil and gas prospective areas, detection of possibles deposits of ferrous, non-ferrous and rare-earth metalls, and exploration of huge deposits of minerals. The determination of points of higher density allows to coordenate and unite all national surveys.

As the temporal changes of gravimetric force on the are very small, gravimetric survey data can be considered as the basic data which can be used by the customers in any time. That is why it is feasible to perform these works constantly, and also this is connected to the fact that determination of gravimetric Earth field paraneters must be carried out every 7- 8 years.

So the importance of assingments which can be solved by gravimetric data is evident.

Nowadays Moscow airgeodetic enterprise has powerfull facilities and large amount of different gravimetric and navegation equipment. The enterprise has a unic in the USSR team, which can carry out all kinds gravimetric works and shelf survey. The works are done by qualified staff. The data are processed in gravimetric laboratory with highly experienced personnel.

Our enterprise can assist to anybody who is interested in integrated study of shelf and Earth gravitation field.

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CARTOGRAPHIC DATA ACQUISITION AND SUPPORTING ACTIVITIES: ACQUISITION OF CARTOGRAPHIC DATA FROM AIRBORNE AND SPACE PLATFORMS

Application of Soviet remote sensing data for studies of natural resources and mapping purposes

Paper submitted by the USSR**

* E/CONF.83/1.

** Prepared by Dr. V. Piskulin, Director-General of SOJUZKARTA, Moscow.

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The problems of food supplies, energy and ecology are now more and more important among a variety of issues which arose in the constantly developing world of today. The growth of population and consequently of needs in food supplies, the increase in power consumption, atmospheric and hydrospheric pollution worry scientists and governments of many countries and also common people of the planet as a growing danger of ecological crisis. These problems can be solved by effective application of results of scientific and technical progress. Natural resources studies and human environment control by remote sensing can be considered as one of the most important directions of scientific progress.

When compared with traditional on-land and air survey methods of studies, remote sensing enables to programme in advance image specifications of the areas regarding scales and spectral bands, to reduce expenses on obtaining and processing of any kind of initial data, to guarantee a combination of large area coverage and identification of final data bulks.

The Soviet experience shows that remote-sensing data can be successfully used in 300 different scientific and economic fields. Soviet space system supplies satellite data for more than 1,000 organizations and ministries. Yearly customers receive up to 1 million of images which can be applied in:

- planning of economic development, nature management of great territories;
- environment control;
- hydrometeorological forecasts;
- minerals and under-soil deposits prospection;
- assessment of agricultural resources, land and forest cadastre;
- estimation of water reserves and hydraulic resources;
- evaluation and determination of areas classified by mudflows, avalanches and seismic hazard;
- design of huge construction and hydrotechnical projects, railways and roads, oil and gas pipelines;
- "off-shore" investigations, sea and ocean studies;
- location of biologically productive areas, places promising in fishery;
- map compilation and updating, specifically for areas of difficult access (for example, Antarctica, high mountains, Amazonia, etc.).

The Soviet Union has considerable experience in application of remote-sensing data in all the above-mentioned activities. Let me specify some brief examples.

Geological interpretation of spectrozonal space images over the eastern coast of the Caspian Sea identified 66 structures promising for oil and gas deposits, including 10 structures on the sea bottom up to 15 metres of depth. At the same time, more than 30 big fractures with polimetallic deposits were found.

The best result in hydrogeological interpretation gives application of non-direct features.

In semi-desert area of Middle Asia, significant reserves of sweet water covered by moving sands were found. Drilling confirmed availability of water which can be used for pastures purposes.

Earliest space location of forest fires, specifically in underpopulated Siberia allows to protect timber resources, reduce air pollution, provide for ecological balance, etc. Space data can be practically applied for forest mapping, elaboration of projects of forest exploration and reproduction, early identification of diseases and insects.

Space images allows to study sea bottom relief, its geological structure, vegetation areals, currents, water pollution, etc. In favourable illumination conditions and water transparency the images of the bottom up to 30 m depth can be obtained.

Space images are widely used for design of big hydrotechnical facilities, high dams in Caucases and Pamir, construction of oil and gas pipelines in hard accessible and swampy regions of Western Siberia.

Nowadays the mapping of the whole territory of our country is concluded in the scales of 1:25 000, 1:50 000 and smaller. The compilation of maps for Eastern regions, high mountains of PAMIR and TIANG SHIANG was made with application of remote-sensing images. Updating of topographic maps is made now by application of well experienced technology by survey data of cameras KFA-1000 and MK-4 which have high resolution. Space surveys are considerably more efficient in comparison with air survey (3-4 times, which depends on the area). One image of MK-4 camera simultaneously covers the area of 330 square kms, equal to 110 sheets of map in scale 1:50 000. One image of KFA-1000 camera covers 500 square kms, which corresponds to 20 sheets of the map in scale 1:50 000. The scopes of field works are considerably reduced as the images of similar objects are identically illuminated and have equal optical density, which allows after interpretation of the first object to find easily analogic objects over total image area.

So it's possible in these conditions to computerized space images interpretation and mapping processes.

Now Soviet cartography promptly and reliably contributes to the exploration of Western Siberian industrial complex, oil and gas prospection in West Siberia and the North, construction of long pipelines and hydropower stations, overcoming the problems of Caspian and Aral seas and others.

I would like to draw your attention to the following figures. By United Nations estimations, African and South American countries are only 30 per cent covered by topographic survey in scale 1:50 000. A quarter of a century will be needed for mapping in this scale by traditional methods. Annual portion of available maps updating makes only 2-3 per cent.

The situation with the maps in scale 1:25 000 is even worse - 1.5 per cent in Africa and 6.7 per cent in South America. United Nations experts think that compilation of these maps will take 135 years.

Taking into account that the majority of investigations of natural resources in any field require the results presented on a map, cartographic issues of any country have the prior significance. And high resolution space images with stereoscopic processing possibilities can speed up mapping by simultaneous natural resources studies.

Soviet foreign economic association SOJUZKARTA is the sole exporter of remote-sensing data.

For most efficient application of remote-sensing data we render relevant consultations and vocational training of customer specialists in different trends of space information use.

SOJUZKARTA in its activities firmly follows the "Principles of Remote Sensing" adopted by the forty-first session of the United Nations General Assembly on 3 December 1986. Strict observance of these principles is agreed upon by SOJUZKARTA and its customers when they purchase the data over the third territories.

SOJUZKARTA represents on the foreign market the Soviet geodetic services - General Administration for geodesy and cartography GUGK USSR. This Administration consists of 3 research institutes, 25 topographic and geodetic regional services, 3 geodetic and photogrammetric tools producing plants, 10 cartographic factories. Soviet geodests and cartographers made and compensated enormous astronomic-geodetic and levelling network of high accuracy, performed mapping of the whole country in scale 1:25 000.

Hundreds of specialists from GUGK USSR are working in Asian, African and Latin American countries, rendering technical assistance in developing national geodetic services, carrying out topographic, geodetic and air survey and cartographic works.

In the last years big works were finalized in Angola, Afghanistan, Iran, Cuba, Nicaragua, Mozambique, Mongolia, Viet Nam, Yemen, the Libyan Arab Jamahiriya, Ethiopia and other countries.

The works are done by large missions up to 100 men each equipped with modern air survey crafts, helicopters, powerful transport facilities, required geodetic instruments and equipment.

Besides, SOJUZKARTA performs geodetic works for construction and prospection operations, geodetic and mining geodetic support of geological and mineral extraction works, carries out topographic survey of "off-shore" area, lakes and seas, surveys underwater communication lines. We render know-how and engineering services, sell technology and software for geodesy and cartography.

Association can export for remote-sensing data processing the following instruments which are not available from any other company:

CONTACT - 1 - contact printing and composite device;

CPM-1 - multiband composite projector;

PC-1 - composite device for compositing multispectral images with five times enlargement.

SOJUZKARTA offers a large variety of geodetic tools: technical theodolites, medium and high accuracy theodolites, astronomic universal tools, distance meters, electronic taqueometres, all kinds of levels, pipefinders, geodetic rools, photogrammetric equipment, gravimeters.

SOJUZKARTA yearly exports many different cartographic products - maps, atlases, globes, relief maps, including special, educational and tourist maps, made with application of remote-sensing data. Maps and atlases are edited in Russian, English, German, French and Spanish. Upon desire of the customer, several maps can be published in the language of the customer's country.

The world knows the high informative content of our maps and substention of Soviet atlases (for example: BIG WORLD ATLAS). In the nearest days detailed plan of Moscow (scale 1:38900, 1:15 000 - central part) will be published in English, German and French.

In conclusion, I'd like to say that SOJUZKARTA basing on scientific and industrial potentialities of Soviet geodetic services is ready to perform the above-mentioned works in any place in the world with high quality and in due time.

For implementation of huge projects, SOJUZKARTA co-operates with scientists and experts from the Soviet Ministry of Geology, Water Management Ministry, National Hydrometeorology Committee, General Space Organisation, Academy of Science, and other.

We are ready for beneficial co-operation with companies from all countries of the world.

Nowadays, SOJUZKARTA has agency agreements with the companies from the United States of America, Australia, Japan, China, Peru, Argentina, Brazil, etc.; we are dealing about this matter with Belgium and Great Britain.

We think that scientific and business people from Great Britain and Europe can widely use our space images, specifically for implementation of big joint projects in the third countries.

I hope that the meeting of today will make a part of widening dialogue between East and USSR and that the relations in the field of science and technology, particularly, in practical application of remote-sensing data, will make an important stage in developing of co-operation between the Soviet Union and Thailand.

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CARTOGRAPHIC DATA RECORDING, COMPILATION AND MANIPULATION: THEMATIC MAPPING

The global problem of underdevelopment and its cartographic interpretation in complex atlases

Paper submitted by the USSR**

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* E/CONF.83/1.

** Prepared by Mrs. L. A. Fokina, Production Cartographic Association (Kartografia), Moscow.

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The report is dedicated to the task of mapping the global problems of today in complex atlases of large world areas (continents and subcontinents). This work considers the idea of creating conceptionally, structurally and substantionally new cartographic works. In the report the indices for cartographic interpretation of global problem of backwardness are proposed.

In the second part of the XX century the humanity realized that the world its natural complexes, political, social-economic and cultural structures are fragile. This idea converted into the contemporary global problem conception.

The number of global problems includes the problems, which emergence is connected with the modern stage of economic and international relations development trends, society and nature interaction in condition of speeding up the scientific and technological progress. In the first place there are the problems of abolishing the menace of nuclear war and maintaining peace on earth, ecological, natural resource and energetic, demographic and food problem connected with them, and also the problem of overcoming backwardness in developing countries, which is the most urgent for millions of inhabitants of Asia, Africa and Latin America.

The global problem studies, which have for an object the search of approaches for their solving - is one of the main tasks of today science, including geography (its global regional geographic orientation). The task of geographic study of global problems suppose the perfection of systematical mapping, namely its "problematization". We keep in view the creation of cartographic products, which disclose thoroughly and completely the global problems of humanity, their genesis and interaction. Traditional regional geographic atlases are not equal to the task at hand. In real life some regions and countries come across not only one isolated problem, but with the whole complex of problems, which differs from region to region. To our opinion the systematic studies of global problems should be realized in the elaboration of the large region atlas serials, completed with the global cartographic publication.

The difficulty of mapping the global problems lies in the fact, that the problem - regional geographic trend of geographic researches just began to set. There is no common opinion among the scientists concerning definition of global problems, causes of their appearance, hierarchy and interaction. Such situation gives us the right to formulate our point of departure and definition of global problems for solving the applied problem - the elaboration of problem oriented atlases.

At the first approach we define contemporary global problems, as a complicated complex of phenomena and processes in nature and society, presenting the menace of annihilation, regress and stagnation of human civilization. It is important that besides the global changes in geographic cover and its components, the functioning of certain social forces can be source of menace, lying in the foundation of global problems. In this case we can speak not only about military and ecological security, but also about socio-economic one. According to such interpretation the menace of isolation from determined trends of world development, uninclusion in them, the menace of conservation and diffusion of social inequality, dependence, exploitation in different spheres and forms appears to be the substance of the

problem of backwardness of developing countries. The task of cartographic interpretation of this problem comes to the demonstration of the level of development of mapped region at the allworld background.

The evaluation of the levels of development by countries were conducted by Soviet and foreign scientists not once, including the cases, when it was done to elaborate the regional geographic typology. There is a great number of approaches to construct such classification schemes, having different criteria in its basis. We suppose that the most perspective estimation of the levels of development uses the economic indices, which characterize both the productive forces and the relations of production and the culture also. According to such method the "human factor" is included in the action, without which any comparison is nonsense. The estimation of the countries by the levels of development requires the application of the whole system of indices, which reflects the similarity and the difference of these countries, and their economies full enough. The increase of the number of indices permits us to characterize the countries of region in detail. But it can be done only to certain extent because of deficiency in international information materials.

The system of indices is proposed for mapping the problem of backwardness of the developing countries in the global regional geographic atlases. It consists of the following points:

1. The summarized indices of productive forces development. They comprise of gross national product per capita and its structure, national income per capita and by able bodied, factor of industrialization etc. The situation (equal or not) in international division of labour can be demonstrated by the percentage of the country of the region in its gross domestic product sum. The factor of industrialization laid on map, shows the differentiation among the countries according to the degree of industrial development.

2. The indices, characterizing the sector structure of economy, such as employment in different sectors.

3. The indices of technological and economic production level and material productive forces development. They include the indices of energy production and its per capita, consumption, territory transport development, agricultural mechanization degree the number of tractors per arable land unit etc.

4. The indices of scientific and technological production level, such as expenditures on scientific studies, research and development (R&D) and the number of scientists and engineers per 1 million residents.

5. The indices, characterizing the position of the region countries in international division of labour: percentage of the region countries in world trade; direction of foreign trade, the share of export in gross national product, export and import volume and structure.

6. Initial and the calculated indices of outers liabilities of the region countries. As it is known they include not only the total sums of accumulated debt, but the information about the correlation of the outer debt with the

possibilities of economy i.e. the share of debt in the gross national product, export volume in the currency reserve of the country etc. Using these indices one can estimate - the solvency of any individual country. The characteristic of loans application taken from different credit sources is also important to reflect the socio-economic situation in the countries.

7. The indices of cultural and health services development levels and consumption level showing the level of development of human element of productive forces: the number of literate rated by 1,000 inhabitants, the number of students by 1,000 inhabitants, percentage of students studying abroad; expenditures on education and health services, the number of inhabitants served by each doctor, average duration of life, the degree of immunization of children, the number of issues of newspapers per 1,000 residents, the number of TV sets and radio sets per 1,000 residents, etc.

We can add the indices of "militarization" degree of economy to all mentioned above, i.e. the relative level of military expenses and relative quantity of military forces. Besides that, these indices should supplied with socio-demographic ones.

It should be stressed that these indices alone, or their complexes laid on the map are of little importance. The reader should be able to compare visually these indices with the same indices for the countries of other regions. It can be done in two ways. Firstly, by using the world maps as additional ones and secondly by simple indication of calculated average world values of mapped indices in legend scales. The second way is more preferable for the atlases of large regions, because it permits to lower greatly time labour expenses, and also makes possible to produce atlases more compact.

The principle of "comparability" was successfully tested during the elaboration of the atlas of Africa and we consider, that all problem oriented regional geographic atlases which are worked out for large world regions must possess such properties. It will permit to show the specificity of global problem set, to pick out territories (countries) where the problems are displayed sharply.

Starting the elaboration of the problem oriented atlases it is necessary to solve the whole set of metological questions, concerning their structure (table of contents), selection of territorial units of mapping and methods of representation.

Structurally these atlases can be constructed in different ways. All particular display of global problems have spatial structure to a different degree and can be taken into consideration both in special atlas sections and keeping within the limits of traditional frame - of complex regional economic atlases. The structure of an atlas based on a typology of today global problems is a new approach to the construction of problem oriented atlas. In this case the problem of backwardness should be considered in two interrelated sectors.

The question, concerning the selection of the main cartographic unit for atlas elaboration on large world regions (continents and subcontinents), is solved in favour of the country. Really the state boundaries outline the territory with specific conditions: unit political, administrative organization and economic

régime, and also with peculiar ethnodemographical, cultural, educational and natural background, which influence on the display of global problems. Moreover, the most part of indices, picked out to characterize the global problem of backwardness (gross domestic product, outers state liability and others) are given in international informational materials by countries. This statement also concerns the atlases of global scale. Naturally, that the atlases of separate countries and their parts call for different cartographic units.

The question about the method of interpretation is closely connected with the question concerning cartographic units and indices. Such methods of mapping as choropleth and map diagram, including structural map diagram, are the most suitable, when selecting the indices for the country.

Finally it should be mentioned, that at present time the creation of fundamental global reqional geographic atlases of scientific reference type is a very difficult task and at the first stage it is reasonable to work out the methodics of contemporary global problems mapping after the example of popular scientific cartographic products.

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MANAGEMENT OF NATIONAL MAPPING AND CHARTING PROGRAMMES: EDUCATION AND TRAINING

Problems and principles of general economic mapping of the developed capitalist countries for institutions of higher learning

Paper submitted by the USSR**

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The manuscript considers the questions of elaboration of general economic maps of the capitalist world for higher education. The concrete suggestions of approaches and elements of map content for demonstrative maps are given.

The economic geography of foreign countries occupies the significant part among the disciplines of general education and special branches of science in curriculums of pedagogical and economic institutes, universities and several other higher educational establishments. It permits the future specialist to aquire the necessary theoreticaly grounded and integral approach to study different country types, their economy and its separate components' interactions. The economic geography gives the concrete knowledge of geographic distribution of population, natural resources' potential,economic regions of different countries in the system of international division of labour.

Different cartographic training appliances are the powerful and effective means of increasing the level of geography training, developing the skills of independent creative thinking, improving the conditions for individual studies and corresponding to contemporary requirements of training scheme organization.

In the Main Administration of Geodesy and Cartography (MAGC) under the scientific and methodological guidance of Department of Cartography (Faculty of Geography, Moscow State University) the works on new map series for higher education are developed. The working plan stipulates the elaboration of the large list of social–economic maps (nearly 1/3 of all maps) of different territorial scope, including the maps of population and cities, general economic maps, the maps of separate industries and transportation, the maps of economic relations and education. General economic maps make up the largest number of maps planned for publication.Particularly numerous is the group of general economic maps of the capitalist countries.

The courses of economic geography of foreign countries and other disciplines,in which the general economic maps of capitalist countries can be used, are studied in higher educational establishments of different

types: universities, pedagogical institutes, economic and financial institutes and in several others. 71 pedagogical institute and 40 universities are among the users of the maps.

The analysis of educational process of training for different specialities shows, that the quantity of disciplines, in which it is advisable to use the general economic maps of foreign countries, the time provided for lectures and for the other kinds of studies (developing practical skills), and also the depth and the fullnes of content of educational courses fluctuate essentially depending on speciality. Making demands for elaboration of general economic maps of capitalist countries and defining their themes and content, we assume, as a basic, those educational establishments, where the economic geography is one of the main subject, and considerable scientific traditions are availiable. These are faculties of geograghy of universities and faculties of natural sciences and of geography of pedagogical institutes.

The needs in cartographic appliances of the other higher schools shouldn't be ignored also, as the application of the maps must facilitate improvement of studying of given science and of forming the cartographic literacy and culture not depending on school type.

The maps for training must satisfy the requirements of the maximum number of teachers and students and, hence, be orientated the principal lecture cources:

1 Introduction in speciality.(Section: Introduction in economic geography).
2 Physical geography of continents and oceans.
3 Economic geography of the USSR.
4 Economic and political (social) geography of foreign countries.
5 Economic cartography.
6 Problems of economic and social geography of the USA.
7 The main problems of economic and political geography of the USA.
8 The main problems of economic and political geography of the Latin American countries.
9 The countries of migrational capitalizm.
10 Economical regionalization and regional programming in capitalist and developing countries.
11 Economic-geographical problems of international capitalist division of labour.
12 Map compilation and editing of social economic maps.
13 Economics of foreign countries.
14 Regional economics.

The principle lecture courses should be provided with the wall maps, which are the most universal and effective visual demonstrative aids. Our proposals concern just that category of appliances.

The necessary metodical demand is the coordination of higher school maps' content with the corresponding sections of the main courses programm, which they are intended for. The legend constuction should be carried out in line with the principles stated in the textbook. Notions, categories and conceptions accepted in the textbook must be represented on the map also. However, if some sections of the course suffer from methodical shortcommings, and the cartographer is able to liquidate them, we can only welcome such creative approach.

The special demand should be made to the visual demonstration properties of wall maps, while mastering the design. All conventional

signs on the map and in the legend should be legible and clearly distinguishable. This demand concerns both the line drowing and the background. The map content should be distinctly read at the distance not less then 10 metres, while conducting lectures in large lecture–halls. It is possible to achive the increase of informativeness of maps and to keep sufficient vividness, showing the part of required content in the "background".The "bigrounded" method provided itself to be useful,while compiling different thematic map series for higher school. It can be applied fully for the general economic maps. In the foreground the required elements of map content should be represented. They are picked out in accordance with the content of the programm sections of the principal courses. The background can be devoted to the elements contained in special courses and for the additional reference information, which heighten the importance of wall map, as independent source of notion.

The important scientific demand is the necessity of correspondence of map themes and content to the requirements of contemporary theory and practice. The wide application of systematic approach in geography and cartography makes it necessary to workout the general economic map serie,as a system of interrelated maps of different territorial levels – global, continental and regional. The territorial levels and composition of the general economic map system is defined in accordance with the structure and content of theoretical courses.The economy of capitalist countries is necessary to map on three territorial levels,as it is seen from the analysis of the programmes, textbooks and manuals. This results in creation of maps of separate countries, group of countries, continents and the whole world. The systematic approach to the subject of mapping requires the usage of systematic principles in methodics of mapping also. Elements of mapping should represent the integral system, corresponding with that ones,subjected to be reflected on the map. Thoughtout system of indices, used for the system components and for the whole system should promote the idea. The systematic general economic mapping can be conducted in different directions. The first direction is realized by the elaboration of the synthetic map of social–economic territorial systems with the integral characteristic of the complex of the national economy. The second – is carried out by the compilation of the analytic maps. The Synthetic maps are more informative. They are resultant in the process of cognition of territorial social–economic systems. The methods of synthesis implementation on such maps can vary.

The capitalist economy differs from the socialist one in its objective function and another development trends.That causes the fundamental distinctions both the organizational and the structural character. Therefore, the approaches to map representation of the countries with different social order should be different. To our opinion the typologic approach in general economic mapping can adequately reflect the contemporary notion of spatial organization of social–economic systems.

The important stage in researching the necessity in general economic maps in higher schools is the analysis of experience in general economic mapping and providing the training process with such maps.

The greatest experience is gained in the process of map elaboration for complex regional atlases and complex world atlases. The type of general economic map, representing the combination of the main branches – industry, agriculture and transportation, is settled by tradition in our country for the maps of mass publications. The manufacturing is shown in places . by scaled circular diagram signs in accordance with the size of

gross product. The characteristic of branches is given in the sign sectors.The scaled conventional signs, located in mining centres are used to show mining. Agriculture is represented by regions of specialization (colored background), ways of communications and goods traffic – by linear signs and lines of movement. Most often the characteristics of economy branches is given in incomparable indicators.

Theoretical and methodical researches and practical developments in general economic mapping arouse interest from the point of view of application of new approaches. As a rule, they find realization in scientific and reference publications. There are some attempts of integral representation of social – economic systems by the means of synthetic indices. Taxonomic method is used to characterize the economic places. The typological characteristic of economic places is given according to their economic functions, degree and level of economic development and importance in economy. The experience in elaboration of integral economic background described in compliance with the character of economic usage of territory is also available. There is original example of typology application on the basis of energy production cycles concept.

The elaboration of general economic maps for higher school represents a special section in general economic mapping, combining the fullness and depth of map content in scientific reference atlases with visual and vivid properties of school supplies. Valuable experience is gained in elaboration of general economic maps of principally new type on the territory of East European countries, the USSR, and historical economic maps of Russia.The system approach and typological characteristics of map content were effectively used in elaboration.

The general economic maps seldom can be found in foreign atlases, especially separately published maps. But most of them are similar to the type, established in our country. There is interesting experience of applying some new methods: the application of results of factor analysis for description of "economic welfare" in centres and counties (The Economic Atlas of Ontario,1969),the example of integral characteristic of economy by means of complexing the great amount of analytic characteristics on general economic map (Atlas Deutsche Demokratische Republik,1978), the typology model of centres' characteristics (Rand McNally Commercial Atlas,1988), the showing of information, representing the synthetic conclusion of analytic social–economic investigation. More over,as the principle subject of mapping are chosen both the spacial economy structures (economic landscape) and the influence of social and economic factors on human life (conditions of living) (Atlas Slovenskej Socialistickey Republiky,1980).

Methods and approaches to elaboration of general economic maps, published in the USSR on the territory of capitalist countries and continents almost doesn't differ from traditional ones, used for mapping the USSR and the other countries with centralized economies.In the most complex way the economy of highly developed capitalist country was reflected in the Atlas of the USA (1966). But it concerns not so much of the general economic maps of the USA regions, placed in it, as the application of systematic approach in selection of social–economic topics for the maps of economy sectors and combining the analytic, synthetic and complex characteristics, while developing the atlas.

The most part of general economic maps of capitalist world is compiled for the educational purpose. However, the maps specially intended for training specialists of higher qualification on such regions never was

published before. The educational wall maps for secondary school, maps in textbooks, forming a numerous and devercified map group, manuscript experimental map models and the maps of non-educational purpose from the different scientific reference atlases are used in higher school most often.

The first serie of school economic wall maps on several foreign countries was published 1952. Among others were the maps of the USA, Great Britain, France. But the maps were not equal to the methodic of traning. The development of contemporary school maps strictly regulated. They are compiled in accordance with the uniform principles and technology stated in Technologycal Instructions of MAGC. The type of maps is fully traditional. However, the new approaches improving school maps are being searched now in connection with the school reformation and appearance of new non-formal methodics of education.

The main difficulties concern the selection and application of indices. All indices, which are used today have both merits and demerits. The universal indices, representing all components of economy complex are not found. The indices of employment in different activity sectors, gross product indices (value and physical output), gross national product indices, population and expert estimation are in common usage. More often synthetic indices are used, while elaborating typologies. In index formula a diversified set of particular indices and, also, the weight coefficients of every index in accordance with its importance and the coefficients, which help to take into account the regional specificity, etc. are inserted.

Taking into considiration methodical and practical experience, the following approaches to general economic mapping for higher school are suggested:

1. Differential approach to mapping the countries with different social and political systems. It is necessary to show the level and pecularity of country development. Demonstration of levels of capitalizm development in different industries and territorial structure of economy for highly developed countries is of great importance.
2. Systematic approach to reflection social and economic conditions. The mapped phenomena are considered to be the social-economic territorial systems and subsystems of different ranks, having various levels of development. The territorial systems, of both the lower level - economic and industrial places, and more complicated - economic nods, zones, regions, can be characterized on the map.
3. Typological approach to realization of transition from traditional analytic method of general economic map compilation to synthetic one. This will permit to reproduce adequately the contemporary knowledge of spatial organization and development of social-economic systems, to represent the complicacy and peculiarity of combinations and functional characteristics, involvement of population in production and social infrastructure. Developing the typological classifications of economic objects, it is recommended to analyse the employment structure not only by industries, but also by the other economy sectors: transportation, finance, trade, private and professional services, governmental and military services. Differentiation of agriculture is suggested to conduct, using the method of typological regionalization with the obligatory showing of three aspects: social - economic type of farming, specialization in farm production and intensity of farming.
4. The application of new kinds and technologies of mapping (mathematic cartographic modeling, automatization) permiting to accelerate the processing of information and to perfect objectivity of its

representation.

We suppose that realization of mentioned above approaches will allow us to create general economic maps meeting up-to-date requirements.